Continental J. Medical Research 2: 35 - 38, 2008

THE VIRULENCE OF *PLASMODIUM FALCIPARUM* INFECTION IN HUMAN HOST

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ABSTRACT
Malaria causes an acute febrile illness which may be characterized by periods of fibrile paroxysms. The severity and course of an attack of malaria depends on species and strains of the infecting parasite. Mankind is infected by four species of the genus *Plasmodium* but *Plasmodium falciparum* is associated with the highest degree of parasitaema due to high yields of merozoites per schizonts. The malignancy of *Plasmodium falciparum* is peculiar to that species. This review highlights some of the reasons why infection by *Plasmodium falciparum* may be malignant and more virulent than the other plasmodia species.

KEYWORDS: malaria parasite, virulence, merozoite, sequestration.

INTRODUCTION

Malaria is the most important parasitic disease of man. The human disease is a protozoa infection of red blood cells which is transmitted by the bite of blood-feeding female anopheles mosquito (White, 1996)

Malaria is found throughout the tropical region of the world, most of the Sub – Saharan Africa, South America, South East Asia and the Western Pacific Areas (Lucas, and Gilles, (1987), Gilles, (1993a).

Malaria transmission occurs in more than 100 countries of the world. More than one billion inhabitants of these countries are exposed to risks of malaria infection. The estimated annual global incidence of malaria is over two million cases (White, (1996), Strickland, (1991).

Malaria is highly endemic in Nigeria and is one of the major causes of ill- health and deaths. The risk of malaria exists throughout the country but is greater in the rural areas. Malaria leads to about 10 percent deaths in children under five years of age and similarly, it causes about five percent of death in Uganda (National Malaria and Vector Control Division , (1991), Bitawaha *et al*, 1997).

The causative agent of this parasitic disease is *Plasmodium*. In nature, malaria is transmitted from man to man by a female anopheles mosquito while taking a blood meal. About 60 species of anopheles mosquitos are important vectors and are found most frequently in tropical and sub – tropical regions.

About 40 species have been identified in Nigeria, but the major vectors of human malaria are *Anopheles gambiae, Anopheles arabiense*, *Anopheles funestus*, and *Anopheles melas*. Out of the six zoo-geographical regions of the world, the most important vector in the Afro – Tropical zone including Nigeria is the *Anopheles gambiae* (Service, 1993).

Mankind is infected by four species of the genus *Plasmodium*. These are *Plasmodium falciparun*, Plasmodium *ovale, Plasmodium vivax* and *plasmodium malaria*.

Plasmodium ovale has been reported predominantly from East and West Africa. It is uncommon outside Africa.

Plasmodium vivax is the major species in the temperate zones, Central America, and the Indian sub-continent. But *Plasmodium falciparum* has increased in India over the last decades. This is due to the transfer of anopheles mosquitoes on board of aircraft during stop – over's in endemic zones. This is why

International regulations sanctions the spraying of planes with insecticides in malaria zones before take off (Bouree *et al*, 1993).

Plasmodium malaria is less common but is found in most areas especially in West and Central Africa.

Plasmodium falciparum predominates in the Sub – Saharan Africa, Papua New Guinea and Haiti (Isselbacher *et al*, 1994)
The severity and course of an attack of malaria depends on the species of infecting parasite, on the age of the patient, state of immunity, general health and nutritional status of the patient.

Falciparum malaria is responsible for almost the entire 2 million deaths attributed to malaria each year worldwide. Of all the species of plasmodia, *Plasmodium falciparum* is the most highly pathogenic, and is associated with malignant type of malaria. It is the chief infection in areas of endemic malaria in Africa, and in a non- immune patient, it usually runs an acute course. Such course could be fatal unless promptly treated with specific drugs. *Plasmodium* falciparum is associated with the heaviest degree of parasitaemia. Infection with human malaria begins when the feeding female anopheline mosquito inoculates plasmodial sporozoites into the human host (Table 1). These migrate into the liver cells and the process of asexual reproduction called pre – erythrocytic schizogony starts.

This process result into schizonts which enlarge, while the nucleus and cytoplasm divides to form thousands of merozoites, which eventually leads to the rupturing of the liver cells. This process librates thousands of merozoites into the circulation to penetrate red blood cells.

The sporozoites of *Plasmodium falciparum* yields about 30,000 – 40,000 merozoites per sporozoite, while the merozoites yield per sporozoite is lower in the other species (Gilles,1993b).

Also, the nuclear division is faster in the *Plasmodium falciparum* species.

Table 1: Some comparative character of sporogonic and schizogonic stages of four species of human plasmodium

Species	Duration of sporogony in anopheles (at 28^0C)	Duration of pre – erythrocytic stage in human	Hypnozoite	Number of merozoite in pre-erythrocytic schizont
P. vivax	8-10 days	6-8days	+	10, 000
P. malaria	14-16days	14-16days	0	15, 000
P. ovale	12-14days	9days	+	15, 000
P.falciparum	9-10days	5½ – 7days	0	30, 000

Source: Gilles, (1993b)

The malignancy of *falciparum* malaria is peculiar to that species. The merozoite emerging from the liver are considerably more numerous than those of the other species.

Also, the merozoites of *Plasmodium falciparum* appear to enter the erythrocytes more efficiently than the merozoites of the other malaria parasites.

Plasmodium falciparum is the only human malaria parasite that is found in equal numbers in erythrocyte of all ages. *Plasmodium vivax* for example, invades primary the reticulocytes, while *Plasmodium malariae* seems to prefer the older, natural red blood cells (Gilles, 1993b).

Again, the severity of malaria infection caused by *Plasmodium falciparum* is made even worse by the increasing resistance to commonly used anti-malaria drugs. Resistance to chloroquine has been documented in most countries with *falciparum* transmission over the last two decades and resistance to other alternate

anti-malarial drugs has followed in many counties of the world (Olatunde, (1977), Eke, (1979), Salako, and Fedeke-Aderounmu, (1987), Oduola (1992), Hagos (1993).

Some prior treatment is extremely common, particularly in developing countries where drugs such as chloroquine are sold across the counter for treatment of fevers and suspected malaria. This action has helped in a very large way in spreading resistant strains of *falciparum* malaria.

Another factor that aids the virulence or malignancy of *Plasmodium falciparum* is the process of sequestration of parasitized red blood cells. At about 24-26 hours of development of the parasite in the human host, the *falciparum* parasite which has infected red blood cells disappears from the circulation by attachment or cycle-adherence to the wall of venules and capillaries in vital organs vis-a-vis, brain heart, placenta, spleen, intestine and bone marrow (Gilles , 1993). It has been demonstrated that sequestration of red blood cells containing mature forms of the parasites in capillaries and post-capillaries venules appears to be a constant feature of severe *falciparum* malaria (Macpherson *et al*, 1985). Most of the fatal cases show blocking or occlusion of the capillaries by clumps of red blood cells harbouring developing parasite, huge number of which can be seen in smears and sections of post-mortem materials.

This process of sequestration leads to reduction in the supply of oxygen and other nutrients to the affected organs. Notably, sequestration is not seen in the other relatively bargain human malaria.

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Received for Publication: 28/09/2008
Accepted for Publication: 04/12/2008

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